BALANCING AGRONOMICS AND ECONOMICS OF ALFALFA HAY PRODUCTION

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Alfalfa has high-yielding, high-quality, persistent, and profitable potential if given adequate management and a balance of several agronomic and economic considerations. How can we account for the differences among producers who have the average alfalfa yields of 3.0 tons/A with the top hay producers who average approximately 5.0 tons/acre and the producer who has achieved the record yield of 10.13 tons/acre? Is the answer "luck", better soils, moisture and growing conditions? The answer may certainly be yes, but. Yes, the factors above are important and can explain some differences; however, we believe the overall difference is the management of research-based farmer-proven "agronomic and economic practices."

Why can some producers make money on alfalfa hay fields with low yields while others loose money at high yields? Could it be that the farmer with low yields gets high prices and vice versa – well maybe – but it is more likely that profitability resulted in overall management of their agronomic and economic factors to keep cost of production as low as possible and use all marketing strategies available to obtain the best prices.

The purpose of this paper is to examine some of the agronomic practices to see if they are indeed in balance with the economics of producing quality alfalfa hay.

Alfalfa Establishment & Production Cost

Alfalfa is not the cheapest forage crop to establishment with cost ranging from $50 to well over $300 per acre to establish the stand. Production costs can also show considerable variation ranging from $75 to over $300 per acre. Table 1 shows the average cost for establishing and producing an acre of alfalfa hay in the Midwest. In this budget "out of pocket expenses" was $172.21 for establishing and $87.64 for production. Total cost was $382.18 for establishing and $306.01 for production.

Table 1. Economics of alfalfa production in establishment year and succeeding production years. Midwest 2002.

	Establishment per acre	Production per acre
Operating costs		
Input Expenses		
Fertility	$18.00	$38.15
Lime	$39.00	---
Alfalfa Seed	$50.00	---
Herbicide	$13.00	---
Overhead	$12.19	$12.19
Pest Scouting	$5.00	$5.00
Crop Insurance	$7.00	$7.00
Part time labor	---	$4.23
Irrigation	$0.00	$0.00
Energy expenses	$10.91	$9.75
Repair and Maintenance	$7.34	$6.60
Input interest	$9.77	$4.72
Subtotal	$172.21	$87.64
Allocated Overhead		
Land Charge	$75.00	$75.00
Property Taxes	$22.00	$22.00
Management	$6.00	$18.18
Labor	$30.63	$28.21
Interest and Insurance	$46.93	$46.64
Depreciation	$29.41	$28.34
Subtotal	$209.97	$218.37
Total	$382.18	$306.01

Source: Dr. Dan Undersander, University of Wisconsin.

Considerable variations exist when comparing alfalfa hay production budgets (Table 2). We compared budgets from Kentucky and eight other states. Range for establishment was from $112-382 and range for production was $87-423. Average “out-of-pocket” expenses for establishing was $176 and $142 for production.

Table 2. Alfalfa Hay Establishment and Production Cost Averaged Over Nine States.

	Operating Cost $/A		Total Cost $/A	
	Range	Average	Range	Average
Establishment	112-234	176	246-382	285
Production	87-229	142	289-423	331

In this presentation, we will not attempt to "balance" all economic and agronomic factors involved in alfalfa hay production. We will address some of the factors we consider critical to successful, profitable alfalfa hay production.

Select the right soil

This has been one of the most basic agronomic recommendations. Alfalfa requires deep, well-drained, fertile soils for optimum production and persistence. Growing alfalfa on shallow, poorly drained soils will reduce yield and stand life. Let's make this easy and just assume a reduction in productive stand life of two years. Let's further assume an establishment cost of $200/A. Disregarding the two extra years of production and likely more production each of the first two years on the better soils and only look at persistence we find establishment costs on the poor soil of $100 per acre ($200/2 yrs), and an establishment cost of $50/A ($200/4). We balance our agronomic recommendations with positive economic returns.

Soil test and apply needed fertilizer

Without question, the most basic of our agronomic recommendations – but can we always balance with economics. A good friend called one day to indicate he had gotten all his soil test results and was making plans for his fertilizer application and indicated he was having trouble, "balancing his soil test results with his check book." Fertilizer is not cheap, but guessing how much to apply can be very expensive. A soil test is the most important agronomic and economic recommendation we make relative to our overall alfalfa fertility program. If we choose to bypass a soil test and "guess" at the rate we must guess well – too little fertilize and we reduce yield and possibly stand life, too much and we pay a high fertilizer bill.

The University of Kentucky Soil Testing Laboratories charge $4.00 per sample. Counties usually charge for processing and mailing, resulting in a cost to the producer of around $5.00. Some counties have programs that offer some

financial assistance for soil testing. The bottom line is that a soil test is a great "INVESTMENT" in alfalfa establishment and production.

Lime and fertilize as needed: Alfalfa removes large amounts of nutrients from the soil. A ton of alfalfa hay contains up to 60 lbs of nitrogen, 15 lbs of phosphate, 60 lbs of potash, and 30 lbs of calcium, plus the micronutrients. Nitrogen fertilizer is not necessary because alfalfa gets nitrogen form the air by converting atmospheric nitrogen to a chemical form by special bacteria in the nodules on the roots. Soils vary considerably in their ability to supply nutrients. We call your attention to Dr. Monroe Rasnake's paper on page 5 of these proceedings for more detailed information on "Fertilizing Alfalfa for Profit."

Select good varieties and seed on time with the right amount of seed

Establishing a good stand of alfalfa is expensive and time consuming. A failure will drastically increase the establishment cost, result in a year's loss of production and possibly increases soil erosion problems. There are many agronomically important aspects of establishment that are important including: variety selection, seeding rate, date, depth, and seeding method. For most producers it is generally accepted that they can balance agronomics and economics of most of the basic, such as seeding rate, date, depth and method that will result in a uniform distribution of seed in good seed-soil contact at approximately ¼ inch depth. They further realize that there are some seeding date "windows" that will increase chances of success. It's in our opinion that the greatest opportunity in this establishment area to better balance agronomic and economics is variety selection.

Variety Selection: A basic agronomic recommendation is to use high quality seed of a proven variety. The University of Kentucky has a very active and aggressive variety testing program with test locations in Lexington, Princeton, Bowling Green and Eden Shale and occasionally at Quicksand and other locations.

Table 3 shows a seven year average dry matter yield for varieties seeded at Bowling Green, Kentucky in April 1996. Over the seven year period, total yields varied by 8.0 tons per acre form the lowest to highest variety. Since there

Table 3. Dry matter yields (tons/acre) of alfalfa varieties sown April 19, 1996, at Bowling Green, Kentucky.	
Variety	7-yr Total
Garst 631	38.07
WL 324	37.92
Affinity + Z	37.26
WL 252 HQ	37.20
DK 133	37.18
Imperial	37.16
Depend + EV	37.04
TMF-Generation	36.79
Supercuts	36.76
Choice	36.73
645	36.68
DK 127	36.63
Gem	36.28
ABT 405	36.19
Innovator + Z	36.06
Saranac AR	36.03
Demand	35.38
Rushmore	35.34
WL 325 HQ	35.30
Fortress	34.91
Legacy	34.10
Apollo	34.16
Buffalo-B	33.26
Arc	32.67
Buffalo-A	30.42

was no significant differences in dry matter yield over the seven years among the top thirteen varieties let's compare the average of the top with Buffalo-A Table 4. The average of the top 13 had a yield increase of 6.62 T/A over Buffalo-A over the first seven years. Cost per acre for seed of the top varieties was more than Buffalo Table 5. In this case, if we assume an average of $3.50 for top varieties and $1.00 for Buffalo-A then the cost for seeding 15 pounds per acre is $52.50 and $15.00, respectively. When prorated over the first seven years, that is only $5.36 more per year for any of the better varieties.

Table 4. Dry matter yield for average of top thirteen varieties versus Buffalo-A.	
Variety	Dry Matter Yield T/A
Average of Top 13	37.04
Buffalo-A	30.42
Difference	6.62

Table 5. Seed cost per pound and per acre for average of top thirteen and Buffalo-A.			
Variety	Average Seed Cost/lb $	Seed cost/acre @ 15 lbs/A rate $	Seed cost/acre per year $
Average of Top Thirteen	3.50	52.50	7.50
Buffalo-A	1.00	15.00	2.14
Difference	2.50	37.50	5.36

Return on investment will vary depending on price per ton (Table 6); If we assume $80.00 per ton for hay, our return on investment would be $529.60 (80x6.62). We realize there would be some extra cost for twine, mowing more hay, etc., however, after we subtract an additional seed cost of $37.50, we are left with $492.10 which can buy a "whole bunch of baler twine."

Table 6. Economic Return on Investing in Improved Alfalfa Varieties.	
Dollars/Ton	Total*
40	265
60	397
80	530
100	662
120	794

*6.62 T/A increase over seven years.

What conclusions can be made? First, alfalfa is a high yielding crop. Even the worst variety had an average yield of 4.35 T/A over seven years. That

yield is more than our state average. With adequate management, this would have been a profitable variety; however, by investing in any of the top varieties, a potential greater profit of almost $500.00 per acre could have been realized.

Control Pests: Is it always economical to control weeds, insects, and diseases? No! Is it economical to control pests when they reach some threshold that will reduce yield, quality and/or stand persistence? Yes! Assuming that "threshold" is based on sound agronomic data and control measures are selected based on research proven, economically feasible, environmentally sound information.

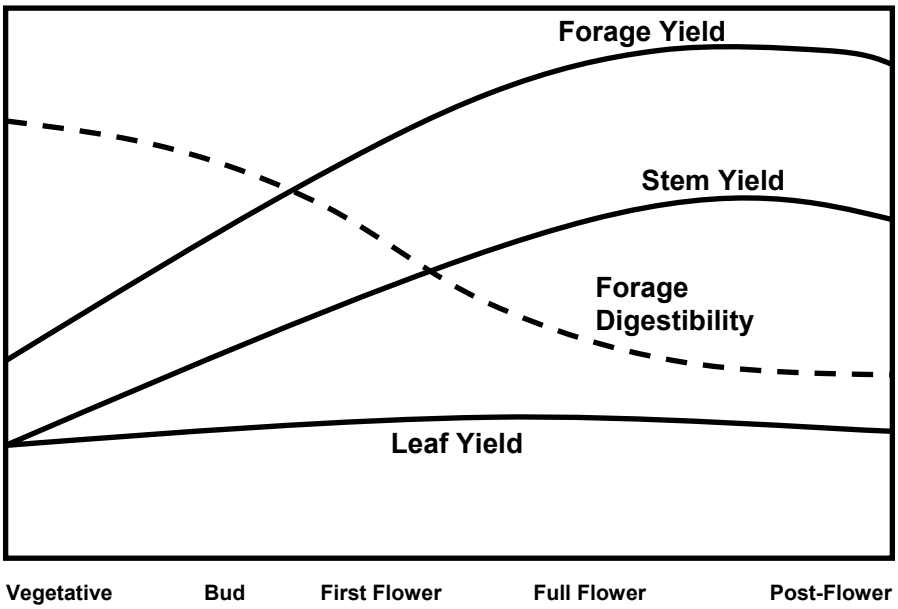
Out first recommendation is to select varieties with as much genetic resistance as possible. Certainly great strides have been made in reference to many diseases, and progress is being made on some insect fronts. With Roundup Ready technology forthcoming perhaps weeds will also be taken care of genetically.

Harvest for Quality

Factors which affect alfalfa hay quality include: growing conditions, harvesting, curing, handling, storage, fertility, varieties, pests and presence of other plant species. However, the stage of maturity when harvested is the most important factor and the one where management can have the greatest impact. As alfalfa plants advance from the vegetative to reproductive stages, fiber and lignin increase, and protein, digestibility, metabolizable energy and acceptability to livestock all decrease (Figure 1). Early cut hay makes a more desirable feed because it contains more of the nutrients associated with high quality. Hay cut at an early stage of maturity is also more palatable and is consumed in larger quantities by livestock. Thus, using early cut hay improves animal performance and reduces the amount of late cut hay needed.

Can we afford to go the extra mile to produce higher quality? This is an excellent question and as an agronomist, I say yes. As an economist, I say maybe. If we sell by the bale and quality is not considered, then the answer is likely No – go for the highest yield and sell "total pounds" of hay. However, buyers and sellers are becoming more quality conscious and alfalfa-quality will play an increasingly important role in marketing.

Figure 1. Forage yield relative to quality at different growth stages.



Let's look further into the aspect of quality. Table 7 shows results of work in Wisconsin relating quality, number of cuts, and milk production. Early-frequent-cut alfalfa was highest in crude protein, lowest in fiber and produced over twice as much milk per acre as late cut, low quality hay. Workers in Tennessee evaluated alfalfa hay and its impact on quality and beef performance (Table 8). Early cut hay was higher in protein, lower in fiber, consumed in higher amounts and produced higher average daily gains.

Table 7. Estimated grade, average concentration of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and milk yield in Wisconsin*.

Estimated Grade	Number of Cuts	CP %	ADF %	NDF %	Milk lb/A
Prime to 1	4	22	31	43	10,688
No. 1	4	21	32	44	9,120
No. 1 to 2	3	19	35	46	7,022
No. 2	2	17	36	48	4,259

SOURCE: Adapted from D.A. Rohweder et al., University of Wisconsin.
*Wisconsin Forage Council Green Gold Project.

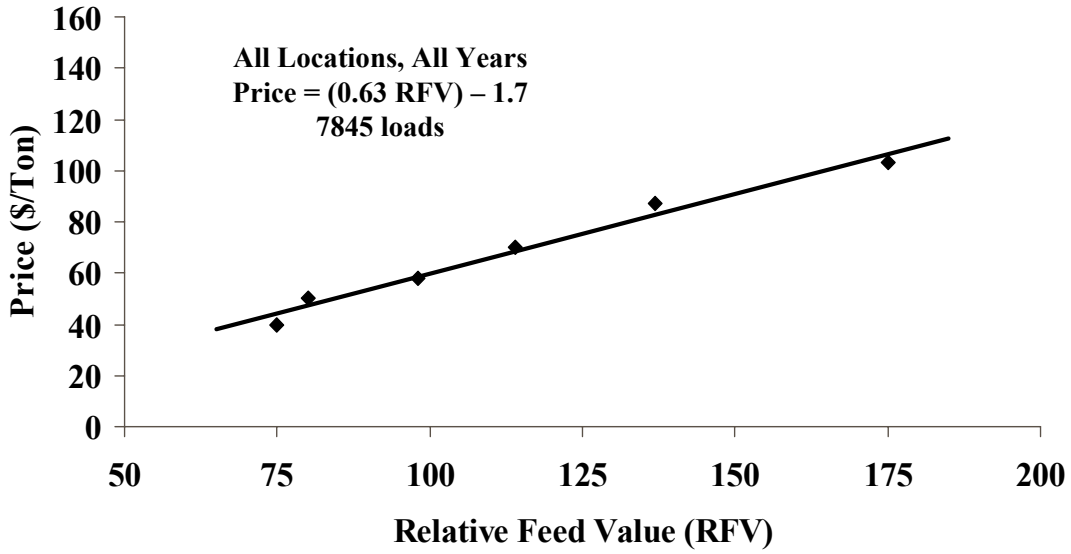
Table 8. Effect of alfalfa hay quality on performance of 550 lb beef steers.			
High Quality	**Good**	**Fair**	**Poor**
Crude Protein	18.7	15.9	13.7
Crude Fiber	29.4	35.4	46.7
Animal Performance			
Hay consumed, lb/day	17.1	16.5	13.8
ADG, lb	1.85	1.49	-0.06

SOURCE: University of Tennessee

The most comprehensive studies relating quality to profit have been done in Wisconsin (Figure 2). Over the past sixteen years with over 7800 lots of quality tested alfalfa hay sold at hay auction there was a highly correlated positive relationship between quality and price. For each one point increase in RFV, there was a corresponding $0.86 increase in price. Recent data (Dr. Dan Undersander) showed that for each day delay in harvest beyond the late bud stage, RFV declined 5 points each day. That represents a change in value of $4.30 (5 points x 86¢/day) loss per day.

FIGURE 2.

1985 - 2001 Auctions



Source: Minnesota Forage UPDATE

Summary

It is not always possible to balance all agronomic recommendations with positive economic returns. Many factors are involved and some beyond our control. Good varieties, well fertilized, and properly managed stands don't produce good yields during droughts; likewise, supply and demand drastically impact price. Research data, along with farmer experiences, have clearly demonstrated that attention to details, wise decision making on management practices, keeping production cost low, wise marketing strategies, along with back-to-basics, tried and proven agronomic recommendations have the greatest potential of resulting in positive, consistent economic returns.